

## **Emergency department visits due to vertebral fractures in the Netherlands, 1986-2008:**

### **Steep increase in the oldest old, strong association with falls**

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## **Abstract**

*Background:* Vertebral fractures are a common consequence of osteoporosis in older persons.

With the ageing of the population, numbers are expected to rise.

*Objective:* To determine trends in health care demand due to vertebral fracture related emergency department (ED) visits and hospitalizations in the older Dutch population.

*Design and setting:* Secular trend analysis of vertebral fracture related ED visits between 1986 and 2008, using the Dutch Injury Surveillance System. All ED visits with a primary diagnosis of a vertebral fracture in persons aged  $\geq 65$  years were extracted from this database.

*Main outcome measure:* Numbers, age-specific and age-adjusted incidence rates (per 100,000 population) of ED visits and hospitalization rates due to vertebral fractures in the older Dutch population were calculated for each year of the study.

*Results:* The total number of ED visits due to a vertebral fracture increased from 913 in 1986 to 2,502 in 2008 (174% increase). The majority of fractures were caused by a low-energetic fall incident (83%). The overall age-adjusted incidence rate increased from 51.6 per 100,000 population in 1986 to 103.6 in 2008. Incidence rates increased with age and were higher in females than in males. The hospitalization rate remained stable at about 50-55%, in both females and males.

*Conclusion:* Vertebral fracture related ED visits and hospitalizations are increasing rapidly in the older Dutch population, especially in the oldest-old. Most vertebral fractures were associated with falls. These findings indicate that a pro-active approach in the diagnosis and treatment of osteoporosis and in the prevention of falls in both men and women is warranted.

## **Key words**

Emergency Department • Vertebral Fractures • Osteoporosis • Falls • Public Health

## Introduction

Osteoporosis is a growing public health concern in developed countries worldwide.<sup>10</sup> It is a skeletal disease, characterized by low bone mass and micro-architectural deterioration, which results in an increased bone fragility and fracture risk.<sup>5</sup> Vertebral fractures are one of the most common osteoporotic fractures. Approximately 90% of vertebral fractures are associated with osteoporosis.<sup>18</sup> Vertebral fractures lead to functional impairment, impaired quality of life and increased mortality.<sup>8, 13, 22</sup> A previous vertebral fracture is associated with an increased risk of further vertebral fractures and hip fractures.<sup>1</sup>

It was estimated that in the year 2000, nine million osteoporotic fractures occurred worldwide, and of these approximately 1.4 million (15%) were clinical vertebral fractures.<sup>12</sup> The majority of vertebral fractures however are morphometric, i.e. clinically silent. The prevalence of radiographically identified vertebral deformities has been estimated to be 5% between the age of 50-54 years, and rises to 50% at age 80-84 years.<sup>19</sup>

The number of patients with a vertebral fracture is expected to increase because of the increasing life expectancy and the increasing number of osteoporotic individuals in the population.<sup>16, 23</sup> However, there is few data on time trends of healthcare demand due to clinical vertebral fractures. The aim of this study was to analyze time-trends in clinical vertebral fractures by analyzing trends in emergency department (ED) visits and hospitalization rates after ED visit.

## Methods

Data on ED visits due to a vertebral fracture in the Dutch population aged 65 years and over was extracted from the Dutch Injury Surveillance System (LIS). The LIS database is a continuous monitoring system in which injury diagnoses and injury mechanisms are registered by using the International Classification of Diseases of the World Health Organization (ICD 10<sup>th</sup> revision).<sup>25</sup> LIS is based on 13 geographically distributed EDs in the Netherlands, resulting in a representative 12% sample of injury-related ED visits. Numbers were extrapolated to national estimates. An extrapolation factor was calculated by the Consumer and Safety Institute (Amsterdam, the Netherlands) based on the adherent population of the participating hospitals and Dutch population numbers in each year of the study. The database makes it possible to measure and describe healthcare use during a specific period. The full-model description has been published by the Consumer and Safety Institute, Amsterdam and has been used previously.<sup>6, 9, 17</sup>

The model was applied to all persons aged 65 years and older who attended an ED between 1986 and 2008. A vertebral fracture was defined using the ICD 10<sup>th</sup> revision.<sup>25</sup> Vertebral fractures were selected based upon the registered primary diagnosis in the LIS. In case of multiple injuries, the primary injury in LIS was determined by application of an algorithm giving priority to spinal cord injury, skull and brain injury, and lower extremity injury above injuries in other body parts, and to fractures above other types of injury to determine the most serious injury. Numbers of ED visits due to vertebral fractures were specified for age and gender. Furthermore, discharge was registered as treated-and-released or treated-and-admitted to calculate the admission rate. Age-specific rates were calculated in 5-year age groups. The overall age-adjusted incidence rate for the population aged 65 years and older was calculated by using “Direct Standardization” to correct for changes in demographics. Incidence rates were expressed per 100,000 person years. A linear regression analysis was used to analyse the age-adjusted incidence rate of vertebral fracture related ED visits over time. The statistical analyses were performed using the Statistical Package for the

Social Sciences (SPSS) software (version 16.1.1). A p-value  $<.05$  was considered statistically significant.

## Results

From 1986 throughout 2008, the population aged  $\geq 65$  years increased from 1.6 million to 2.4 million persons in the Netherlands. During that same period, a total number of 31,650 patients were seen and diagnosed in the ED with a vertebral fracture. The annual number of vertebral fractures requiring ED visits increased with 174% (from 913 in 1986 to 2,502 in 2008), **Table 1**. The majority (83%) of vertebral fractures was related to falls in both males and females; this remained unchanged throughout the study period (**Table 2**).

Gender and age-specific incidence rates are shown in **Table 3**. Incidence rates increased with ageing and were higher in women than in men for all age groups. The crude incidence rate for men increased from 39.3 per 100,000 older adults in 1986 to 82.7 in 2008 (110% increase). The crude incidence rates for women increased from 59.9 per 100,000 older adults in 1986 to 119.4 in 2008 (99% increase). **Figure 1** shows the age-specific incidence rate of vertebral fractures according to 5 year age groups for the periods 1986-1988 and 2006-2008, respectively. The strongest increase in incidence rate occurred in women  $\geq 85$  years, from 88.9 per 100,000 during the period 1986-1990 to 222.8 per 100,000 during the period 2006-2008 (150% increase).

The overall age-adjusted incidence rate for ED visits due to vertebral fractures in older adults increased from 51.9 to 102.3 per 100,000 persons (increase 97%) throughout the study period. The age-adjusted incidence rate in women increased from 59.9 per 100,000 population in 1986 to 116.3 in 2008. For men the age-adjusted incidence rate increased from 39.7 in 1986 to 81.2 per 100,000 population in 2008 (**Figure 2**).

During the period 1991-2008 14,658 patients were admitted to the hospital after being diagnosed with a vertebral fracture at the ED. The absolute number of hospital admissions increased from 631 in 1991 to 1,389 in 2008 (120% increase). The overall percentage of patients admitted from the ED during the whole period was 56%. The percentage of hospital admissions did not change over time and remained between 50-55% for both men and women

during the study period (**Table 1**).

The adjusted incidence rate of hospital admission after an ED visit for a vertebral fracture increased from 32.6 per 100,000 population in 1991 to 57.1 in 2008. The incidence rate increased most in the age group 85-89 years, from 46.2 per 100,000 population in 1991 to 152.0 in 2008 (229% increase).

## Discussion

The aim of this study was to gain insight into secular trends of health care demand due to vertebral fracture related ED visits in the older Dutch population. From 1986 throughout 2008 the absolute number of vertebral fractures requiring an ED visit increased by 174% to over 2,500 ED visits per year. The age-adjusted incidence rate for ED visits nearly doubled (97% increase) over the last two decades. Especially a strong increase in vertebral fracture related ED visits was seen in individuals aged 80 years and over. The hospital admission rate for people diagnosed with a vertebral fracture at the ED remained fairly constant during the study period at about 55% for both men and women. In over 80% of the cases, the vertebral fracture was related to a fall incident.

Data on clinical-epidemiological characteristics of vertebral fractures are scarce and, as far as we are aware, this is the first study to report on national data regarding vertebral fracture related ED visits and hospital admissions with a study period of over two decades. Some studies with a shorter follow-up have examined incidence rates of vertebral fracture related hospital admissions.<sup>2, 14</sup> Vertebral fractures in Spain led to a hospitalization rate of 27.6 per 100,000 population for individuals aged  $\geq 30$  years in the year 2002, with a peak of 108.2 per 100,000 population among individuals aged 80 years and over.<sup>2</sup> The Spanish study showed that vertebral fractures affected predominantly women with a female:male ratio of 1.5:1, which is in line with our data. A second study from the United States reported on vertebral fracture related hospital admissions from 1993 throughout 2004. In this study the admission rate increased from 160.9 per 100,000 United States population in 1993 to 180.9 in 2004.<sup>14</sup> In addition, several studies examined the incidence rate of radiographical vertebral fractures in older individuals. In the Rotterdam Study, an ongoing cohort study in over 7,000 older individuals, the incidence of a radiographically diagnosed vertebral fracture in men aged 65-75 years was 5.1 per 1000 person years. In men aged 75 years and over, the incidence rose to 9.3 per 1000 person years. In women, the incidence was 17.0 in those aged 65-75 years and 19.6 per 1000 person years in those aged 75 years and over.<sup>24</sup>



In the current study, numbers of fall-related and non-fall related vertebral fractures increased equally as strong. The observed increase in both fall- and non-fall related vertebral fractures might have several causes. An important cause for the observed increase in number of vertebral fractures might be the ageing of the population.<sup>23</sup> Nowadays people live longer, often with multiple medical problems.<sup>20</sup> Ageing and frailty are both risk factors for an increased fall risk and for osteoporosis, and could thus contribute to an increase in vertebral fracture incidence. In the present study, about 80% of the vertebral fractures diagnosed at the ED were fall related. In the literature it has been estimated that about 75% of all vertebral fractures that come to clinical attention are precipitated by routine daily activities such as bending, making beds or lifting (light) objects, and that only 25% of all vertebral fractures in older people is the result of a fall-incident.<sup>11</sup> It can be postulated that fall-related vertebral fractures are over-represented because the ED was taken as intake point in our study. Given the fact that a substantial proportion of the acute hospital care for vertebral fractures is fall-related, it seems plausible that in order to reduce the burden of vertebral fracture related acute admissions, the focus should not only be on the treatment of osteoporosis, but also on the reduction of falls in older persons.

While vertebral fractures are the most common osteoporotic fracture, hip fractures are the second most common osteoporotic fracture, and data on time trends of hip fracture is more readily available. Recent data on secular trends of incidence rates for hip fractures reported a trend break in incidence rates of hip fracture in the United States.<sup>3</sup> Since 1995, incidence rates of hip fracture started to decline in the American population aged  $\geq 65$  years, and similar results are reported in a Canadian study.<sup>15</sup> A similar trend break for vertebral fractures was not found in the current study.

The strength of the present study is the availability of continuous ED monitoring system for an extensive period of 22 years. Throughout the study period, no major policy changes that might have affected the increase in admission rates were introduced in the Netherlands. The Dutch health care system was, and continues to be, characterized by full

health insurance coverage and full accessibility for the whole population. Furthermore, the coding system of the LIS did not change during the study period and takes place by official trained coding clerks. A limitation of the use of this linked administrative database is that it does not contain data regarding underlying diagnosis, co-morbidity, treatments or medication use. This hampers the interpretation of causal mechanisms behind the observed trends. Furthermore, readmissions in one calendar year were not excluded and could potentially have led to some “double registrations”. However, readmissions have been shown to contribute to only 2.6% of all injury related hospitalizations in the Netherlands.<sup>21</sup>

The true burden of vertebral fractures in the older Dutch population will probably exceed the numbers as presented in our study, since only a third of all vertebral fractures are currently diagnosed in clinical practice.<sup>7</sup> This low percentage is partly due to under-diagnosis, especially in the oldest old, and to the atypical presentation of patients with a vertebral fracture.<sup>4</sup>

In conclusion, the incidence rate of ED visits in the Netherlands due to a vertebral fracture in persons aged 65 years and over, doubled in the period from 1986 throughout 2008. The increase was most pronounced in the oldest old. A fall was the most frequent cause. This should be a further imperative to a pro-active approach in the diagnosis and treatment of osteoporosis and the prevention of falls in both men and women.

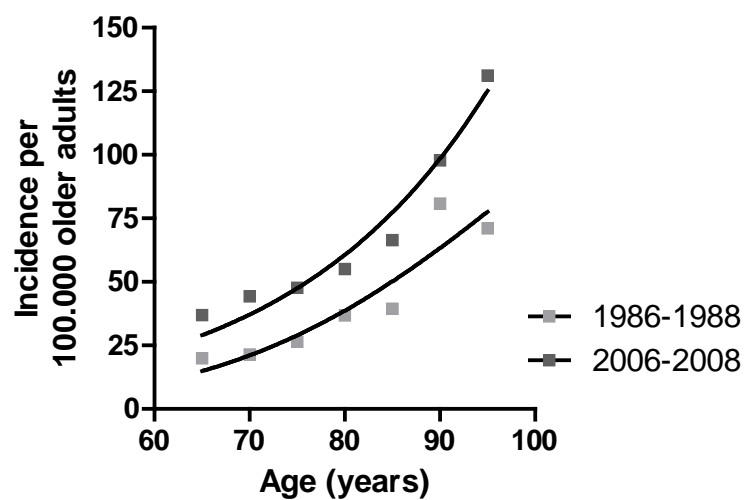
**Conflict of interest statement**

None declared

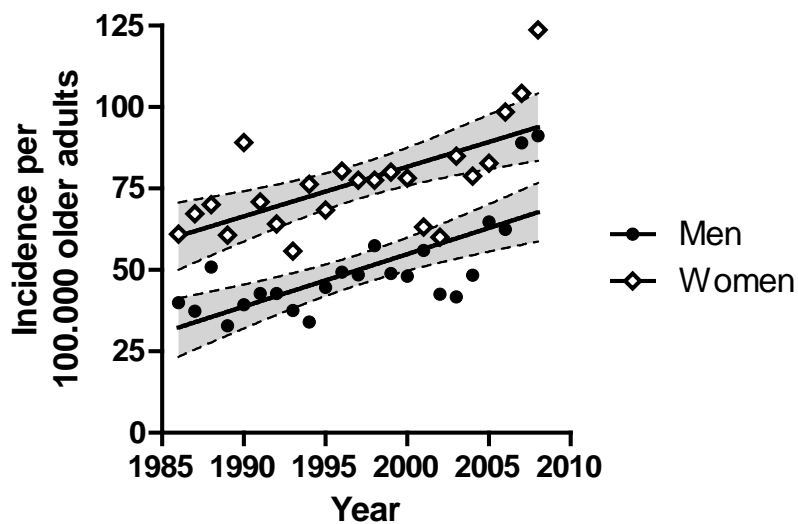
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**Figure 1.** Incidence rate (expressed per 100,000 population) of vertebral fracture related ED visits in the Netherlands per 5 year age-groups; 1986-1988 and 2006-2008.



**Figure 2.** Age-adjusted incidence rate (expressed per 100,000 older persons) of vertebral fracture related ED-visits in persons 65 years and over. The Netherlands, 1986 throughout 2008.



The line indicates the age-adjusted incidence rate of ED visits due to a vertebral fracture and the gray area the 95% confidence interval of the linear regression analysis (Trend is significantly different as zero,  $p < .001$  for both lines)

**Table 1.** Population characteristics of persons aged  $\geq 65$  years, number, incidence, and admissions due to a vertebral fracture (The Netherlands, from 1986 throughout 2008)

Characteristic	1986	1991	1996	2001	2006	2008
Population $\geq 65$ yr (*1,000)	1,769	1,934	2,061	2,175	2,330	2,415
Population female, %	61.2	60.2	59.8	58.9	57.6	57.0
ED incidence rate <sup>†</sup>	51.6	56.6	65.9	60.3	83.1	103.6
ED visits, No.	913	1,095	1,358	1,311	1,938	2,502
- Female, No. (%)	634 (69)	789 (72)	981 (72)	816 (62)	1,328 (69)	1,643 (66)
Hospitalization rate <sup>†</sup>	NA	32.6	36.0	30.0	42.2	57.5
Hospitalized, No. (%)	NA	631 (58)	741 (55)	643 (49)	984 (51)	1389 (55)
- Females, No. (%)	NA	445 (71)	510 (69)	392 (61)	622 (63)	905 (65)

<sup>†</sup> Crude incidence rate, expressed per 100,000 older adults; NA, not available

**Table 2.** Causes of vertebral fractures requiring ED attendance between 1986-2008 in older adults aged 65 years and over in the Netherlands

<b>Trauma mechanism</b>	<b>Males</b>		<b>Females</b>		<b>Overall</b>	
	n	%	n	%	n	%
<b>Fall</b>	7,736	78.7%	18,390	84.3%	26,126	82.5%
<b>MVA</b>	1,481	15.1%	1,835	8.4%	3,316	10.5%
<b>Other</b>	610	6.2%	1,598	7.3%	2,208	7.0%
<b>Total</b>	9,826	100%	21,823	100%	31,650	100%

MVA, Motor Vehicle Accident

**Table 3.** Age-specific incidence rates for vertebral fractures related ED visits in persons  $\geq 65$  years, per 100,000 older persons (The Netherlands, from 1986 throughout 2008)

Age-group, year	65-69		70-74		75-79		80-84		$\geq 85$	
period	men	women	men	women	men	women	men	women	men	women
1986-1990	33.4	38.8	18.9	60.0	58.6	90.7	53.1	95.3	89.5	88.9
1991-1995	17.2	29.8	25.0	40.0	37.1	62.6	48.3	75.3	123.0	124.4
1996-2000	29.8	54.6	33.5	60.0	47.4	69.5	89.2	125.6	151.8	123.1
2001-2005	35.4	37.1	40.2	58.3	59.7	82.3	73.3	94.9	106.1	140.7
2006-2008	51.5	58.4	61.3	70.8	77.9	112.2	113.8	141.0	216.8	222.8



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